K120961

AUG 3 2012

510(K) SUMMARY

Trade Name: Trevo Retriever
Common Name: Catheter, Thrombus Retriever
Classification: Catheter, Thrombus Retriever, 21CFR 870.1250 – Class II
Submitter: Concentric Medical, Inc.
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Vice President, Technology & Regulatory Affairs

Date Prepared: July 27, 2012
Predicate Device: Merci® Retriever (K063774)

Device Description

Like the predicate device, the Trevo Retriever consists of a flexible, tapered core wire with a shaped section at the distal end and is designed to restore blood flow in the neurovasculature by removing thrombus in patients experiencing ischemic stroke. A radiopaque coil at the distal end allows fluoroscopic visualization. Retriever dimensions are indicated on the product label. The Retriever has a hydrophilic coating to reduce friction during use. A torque device and an insertion tool are provided with the Retriever. The proximal end of the device is compatible with the Abbott guide wire extension to facilitate removal or exchange of a catheter while maintaining the Retriever position in the vessel.

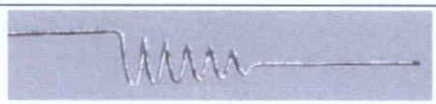
Indications for Use

The Indications for Use are as follows:
The Trevo Retriever is intended to restore blood flow in the neurovasculature by removing thrombus in patients experiencing ischemic stroke within 8 hours of symptom onset. Patients who are ineligible for intravenous tissue plasminogen activator (IV t-PA) or who fail IV t-PA therapy are candidates for treatment.
This is comparable to the predicate device's Indications for Use and does not impact the intended therapeutic use of the device in patients experiencing ischemic stroke or raise different issues of safety and effectiveness. As a result, the safety and effectiveness of the device are not impacted when used as indicated.

Technological Characteristics

There are technological differences between Trevo and the predicate device. The effect of these differences on safety and effectiveness has been addressed in a clinical study which supports that the clinical performance of the two devices is substantially equivalent. **Table 1** provides a comparison between the Trevo device and the predicate Merci device.

Table 1: Comparison of Trevo Retriever Device to the Predicate Merci Retriever Device

Attribute	Predicate Merci Retriever Device (K063774)	Subject Trevo Retriever
Device Description	The Retriever consists of a flexible, tapered core wire with a shaped section at the distal end. A platinum coil allows fluoroscopic visualization. The Retriever has a hydrophilic coating to reduce friction. The Retriever has a shaft marker to indicate proximity of Retriever tip relative to Microcatheter tip. A torque device and insertion tool are provided with the Retriever.	Same as the predicate device
Distal End (shaped section) Configuration		
Anatomical Sites	Neurovasculature	Same as cleared device
Target Population	Patients with symptoms of an ischemic stroke	Same as cleared device
Single/Multiple Use	Single Use	Same as cleared device
Materials		
Core Wire Material	Nitinol (nickel titanium alloy)	Same as cleared device
Distal Shaped Section Material	Nitinol	Same as cleared device
Coil Material Distal to Distal Shaped Section	Platinum/Tungsten	Same as cleared device
Coil Material Proximal to Shaped Section	304 Stainless Steel	Same as cleared device
Solder	Gold/Tin	Same as cleared device
Nominal Design Attributes		
Proximal Core Wire Diameter	0.0137"	0.0180"
Shaped Section Diameter (nominal)	Variable along length ranging from 3mm-1.5mm	4 mm
Shaped Section Length (nominal)	7 mm	20 mm
Distal Tip Length (nominal)	7 mm	4 mm
Overall Length	180 cm	Same as cleared device

Accessory Devices Provided (not in direct contact with patient)	Insertion tool and torque device provided in product package	Same as cleared device
Packaging		
Materials and Configuration	Polyethylene Hoop, polycarbonate mounting card, Tyvek/Film Pouch, MDPE Tubing Clips, Chipboard carton 	Same as cleared device
Sterilization Method	100% EtO	Same as cleared device
How Supplied	Sterile/Single Use	Same as cleared device

Testing Summary

Bench Testing

The results of verification and validation conducted on the Trevo Retriever demonstrate that it performs as designed, is suitable for its intended use and is substantially equivalent to the predicate device. Specifically, the following tests were performed on the proposed device:

- Simulated Use Testing: the device's ability to be used in a neurovascular model per procedural instructions outlined in the Instructions for Use was successfully evaluated.
- Tensile Testing: the device's mechanical integrity under tensile loads was successfully evaluated.
- Radial Force Testing: the resulting radial force when the device is constrained radially was successfully evaluated.
- Tip Deflection Force Testing: the force to deflect the distal tip of the device was successfully evaluated.
- Torque/Tensile Durability: the ability of the device to withstand torque and tensile load cycles without fracture was successfully evaluated.
- Kink Resistance: the ability of the device shaft to resist kinking was successfully evaluated.
- Device safety (vessel response) was successfully evaluated in an animal model

Clinical Testing

To demonstrate substantial equivalence, a randomized, multi-center, prospectively controlled IDE clinical trial (TREVO 2) was conducted comparing the efficacy of the subject Trevo Retriever to the predicate Merci Retriever for removing occlusive thrombi in patients experiencing an ischemic stroke.

Randomization to either the Trevo arm or Merci arm occurred on a 1:1 basis. Assessments for the primary efficacy endpoint were performed post procedure and subjects were followed for up to 90 days (+/- 14 days) for neurological outcomes and safety assessments.

Subject disposition

A total of 178 patients were randomized, 88 to treatment with the Trevo device and 90 to the Merci device. On review by the Core Lab, 81 subjects randomized to Trevo and 82 subjects randomized to Merci met all angiographic entry criteria. An attempt to treat with the device was made in 79 Trevo and 81 Merci subjects. The population for analysis of the primary effectiveness and safety endpoints includes these 160 subjects. All subjects were treated with the device to which they were randomized. There were no subjects with missing endpoint data.

Statistical Analysis

Analysis of the primary efficacy endpoint (successful revascularization of the target occlusion, using the TICI score as the metric) was performed using a one-sided test per Blackwelder's formulation of the primary efficacy non-inferiority hypothesis at the 0.025 level of significance. The primary safety endpoint of the study was the incidence of procedure-related serious adverse events (PRSAEs) through 24 hours post procedure. These events were adjudicated by an independent clinical events committee per protocol. There was no statistical hypothesis related to the primary safety endpoint.

Study Procedures

Diagnostic angiographic data was obtained at baseline (prior to patient randomization), again at the conclusion of revascularization attempts with the assigned study device, and post procedure. 24-hour post-procedure follow-up included CT or MR imaging and NIHSS examination. Follow-up at day 7-10 (or discharge if earlier) and at day 90 (+/-14 days) included NIHSS exam and modified Rankin Scale (mRS).

Inclusion Criteria

- Patient presenting with clinical signs and symptoms consistent with a diagnosis of Acute Ischemic Stroke, and:
    - a. Patient has failed IV t-PA therapy
      Or
    - b. Patient is contraindicated for IV t-PA administration
- Age 18-85 (has had 18th birthday, but not yet had 86th birthday)
- NIHSS $8 \leq$ NIHSS ≤ 29
- Anticipated life expectancy of at least 6 months
- No significant pre-stroke disability (mRS ≤ 1)
- Written informed consent to participate given by patient or legal representative
- Angiographic confirmation of a persistent large vessel occlusion in the internal carotid, middle cerebral (M1 and/or M2 segments), basilar and/or vertebral arteries
- Treatable within 8 hours of symptom onset, defined as the first pass being made with the assigned study device

Exclusion Criteria

- Baseline glucose < 50 mg/dL (2.78 mmol) or > 400 mg / dL (22.20 mmol)
- Known hemorrhagic diathesis, coagulation factor deficiency, or oral anticoagulant therapy with INR > 3.0
- Treated with Heparin within 48 hours with a PTT greater than 2 times the lab normal
- Baseline platelet count < 30,000
- History of severe allergy (more than rash) to contrast medium or nitinol
- Severe, sustained hypertension (SBP>185 mm Hg or DBP>110 mm Hg)

NOTE: If the blood pressure can be successfully reduced and maintained at the acceptable level using medication, the patient can be enrolled

- Pregnancy
- Patient participating in another investigational drug or device study
- CT showing hypodensity or MR showing hyperintensity involving greater than 1/3 of the MCA territory. For non-MCA strokes, CT showing hypodensity or MR showing hyperintensity involving > 100cc of tissue.
- Baseline CT/MR evidence of significant mass effect with midline shift
- Baseline CT evidence of hemorrhage
- Baseline CT/MR evidence of intracranial tumor (except small meningioma)
- Angiographic evidence of vasculitis or arterial dissection
- Stenosis in a proximal vessel that requires treatment or that prevents access to the thrombus with the assigned study device
- Angiographic evidence of excessive arterial tortuosity that would preclude the assigned study device from reaching the thrombus
- Bilateral stroke

Table 2: Summary of Reasons for Exclusion during Angiographic Screening

Reason for Exclusion	Number of Subjects
Angiographic evidence of vasculitis or arterial dissection	0
Angiographic evidence of excessive arterial tortuosity that would preclude the assigned study device from reaching the thrombus	1
Vessel too small	1
No angiographic evidence of a persistent large vessel occlusion in the internal carotid, middle cerebral (M1 and/or M2 segments), basilar and/or vertebral arteries	26*
CT showing hypodensity or MR showing hyperintensity involving greater than 1/3 of the MCA territory (discovery concurrent with angiography)	1
Stenosis in a proximal vessel that requires treatment or that prevents access to the thrombus with the assigned study device	3*

*1 subject had 2 exclusion criteria

Primary Efficacy Endpoint

Primary Efficacy was assessed by the independent Core Lab. Revascularization as measured by TICI was determined for each subject following the use of the assigned study device. Use of any IA lytic or treatment of a proximal carotid stenosis was automatically counted as a revascularization failure regardless of the subjects's revascularization status after use of the device (**Table 3a**). In an additional analysis, subjects were counted as revascularization failures if any adjunctive therapy was used at the site of an occlusion regardless of revascularization status after the use of the assigned study device (**Table 3b**). Subjects with a baseline TICI 2a by Core Lab and subjects in whom the device was never attempted were excluded from both analyses. The test for non-inferiority is highly significant and establishes that the Trevo Retriever is non-inferior and substantially equivalent to the Merci Retriever.

Table 3a: Primary Effectiveness Endpoint for Subjects with Baseline TICI 0 or 1 (by Core Lab), with Study Device Attempted, Any IA lytic Considered as Treatment Failure

Primary Effectiveness Endpoint	Trevo (N=79) % (n/N) [95% CI][a]	Merci (N=81) % (n/N) [95% CI][a]	Difference [95% CI][b]	p-value
Post-Device Revascularization Success (TICI ≥2a)	87.3% (69/79) [78.0%, 93.8%]	58.0% (47/81) [46.5%, 68.9%]	29.3% [15.0%, 42.4%]	<0.0001[c] <0.0001[d]

a: Exact Clopper Pearson confidence intervals on individual proportions; b: Exact confidence intervals on differences in proportions computed with StatXact Version 8; c: Non-inferiority hypothesis using Blackwelder's method with non-inferiority margin of 10%; d: One-sided Fisher's exact test of superiority

Table 3b: Primary Effectiveness Endpoint for Subjects with Baseline TICI 0 or 1 (by Core Lab), with Study Device Attempted, Any Adjunctive Treatment Considered as Treatment Failure

Primary Effectiveness Endpoint	Trevo (N=79) % (n/N) [95% CI][a]	Merci (N=81) % (n/N) [95% CI][a]	Difference [95% CI][b]	p-value
Post-Device Revascularization Success (TICI ≥2a)	79.7% (63/79) [69.2%, 88.0%]	49.4% (40/81) [38.1%, 60.7%]	30.4% [15.0%,44.1%]	<0.0001[c] <0.0001[d]

a: Exact Clopper Pearson confidence intervals on individual proportions; b: Exact confidence intervals on differences in proportions computed with StatXact Version 8; c: Non-inferiority hypothesis using Blackwelder's method with non-inferiority margin of 10%; d: One-sided Fisher's exact test of superiority

Primary Safety Endpoint and Good Outcomes

The incidence of procedure-related serious adverse events through 24 hours post-procedure was reported for the Trevo and Merci arms (**Table 4**). The rate for this composite endpoint was numerically lower in the Trevo arm supporting the safety of the Trevo Retriever. Subjects with a baseline TICI 2a by Corelab and subjects in whom the device was never attempted were excluded from this analysis.

Table 4: Summary of Primary Safety Endpoint and 90-day Good Outcomes

	Trevo N= 79 pts	Merci N= 81 pts	Difference [95% CI][a]	p-Value
Primary Safety Endpoint				
Composite Events [95% Conf. Interval][c]	13.9% (11/79) [7.2%, 23.6%][c]	23.5% (19/81) [14.8%, 34.2%] [c]	-9.5% [-22.1%, 2.8%]	0.1567[b]
Vessel Perforation	0.0% (0/79)	9.9% (8/81)	-9.9% [-18.5%, -3.9%]	
Intramural Arterial Dissection	0.0% (0/79)	1.2% (1/81)	-1.2% [-6.7%, 3.5%]	
Symptomatic ICH	5.1% (4/79)	9.9% (8/81)	-4.8% [-14.1%, 3.8%]	
Embolization to Previously Uninvolved Territory	7.6% (6/79)	4.9% (4/81)	2.7% [-5.6%, 11.4%]	
Access Site Complication Requiring Surgical Repair or Blood Transfusion	1.3% (1/79)	0.0% (0/81)	1.3% [-3.3%, 6.9%]	
Mortality within 24 hrs	1.3% (1/79)	0.0% (0/81)	1.3% [-3.3%, 6.9%]	
in vivo Device Failure	0.0% (0/79)	0.0% (0/81)	0.0% [-4.6%, 4.6%]	
Other PR-SAE	0.0% (0/79)	0.0% (0/81)	0.0% [-4.6%, 4.6%]	
Secondary Endpoint				
Good Outcome at 90 days (mRS ≤ 2)	38.2% (29/76)	17.9% (14/78)	20.2% [6.4%, 34.1%]	

a. Exact computations with StatXact Version 8; b. Fisher's exact test; c. Exact Clopper Pearson confidence intervals on individual proportions

Adverse Events and Mortality in Subjects in whom the Assigned Study Device was Used

Table 5: Summary of Adverse Events

Concentric Medical Classification Term	Trevo Patients N=86 pts	Merci Patients N=89 pts
Units	% (Number of pts) [Number of AEs]	
Total Adverse Events (AE)	96.5% (83) [388]	96.6% (86) [493]
Mortality at 90 days	33.7% (29/86) [29]	23.8% (21/88) [21]
Neurologic	**73.3% (63) [136]**	**83.1% (74) [178]**
Cerebral Edema	15.1% (13) [14]	18.0% (16) [16]
Headache	10.5% (9) [10]	9.0% (8) [8]
Dysphagia (Difficulty Swallowing)	16.3% (14) [14]	27.0% (24) [24]
IVH	5.8% (5) [5]	6.7% (6) [6]
SAH	12.8% (11) [11]	23.6% (21) [21]
ICH – HI -1	14.0% (12) [12]	21.3% (19) [19]
ICH – HI -2	8.1% (7) [7]	6.7% (6) [6]
ICH – PH1	14.0% (12) [12]	21.3% (19) [19]
ICH – PH2	8.1% (7) [7]	5.6% (5) [5]
Neurologic Decline	11.6% (10) [10]	24.7% (22) [22]
Late ICH	4.7% (4) [4]	6.7% (6) [6]
Depression	4.7% (4) [4]	5.6% (5) [5]
Progression of index Stroke	9.3% (8) [8]	6.7% (6) [6]
Cardiac	**37.2% (32) [39]**	**30.3% (27) [43]**
Arrhythmia – Tachycardia	7.0% (6) [6]	3.4% (3) [3]
Atrial Fibrillation	10.5% (9) [9]	7.9% (7) [7]
Hypotension – Sustained - Tx	7.0% (6) [6]	5.6% (5) [6]
Dermatologic	**9.3% (8) [11]**	**7.9% (7) [7]**
Gastrointestinal	**17.4% (15) [16]**	**16.9% (15) [19]**
Constipation	2.3% (2) [2]	5.6% (5) [5]
Nausea and Vomiting (Non-Neuro)	9.3% (8) [8]	3.4% (3) [3]
Hematologic	**18.6% (16) [16]**	**27.0% (24) [28]**
Anemia	16.3% (14) [14]	19.1% (17) [17]
Metabolic	**26.7% (23) [34]**	**33.7% (30) [45]**
Hyperglycemia	9.3% (8) [8]	10.1% (9) [9]
Electrolyte Imbalance	18.6% (16) [23]	27.0% (24) [32]
Musculoskeletal	**14.0% (12) [13]**	**13.5% (12) [19]**
Joint/Extremity Pain	7.0% (6) [6]	11.2% (10) [13]

Concentric Medical Classification Term	Trevo Patients N=86 pts	Merci Patients N=89 pts
Procedural	**12.8% (11) [11]**	**18.0% (16) [17]**
Access Site Complication	5.8% (5) [5]	1.1% (1) [1]
Embolization to Previously Uninvolved Territory	5.8% (5) [5]	4.5% (4) [4]
Vessel Perforation	1.2% (1) [1]	10.1% (9) [9]
Pulmonary	**38.4% (33) [53]**	**50.6% (45) [71]**
Pneumonia	10.5% (9) [11]	23.6% (21) [23]
Pulmonary Edema	4.7% (4) [4]	5.6% (5) [5]
Respiratory Distress	9.3% (8) [9]	3.4% (3) [3]
Respiratory Failure – Acute	5.8% (5) [5]	21.3% (19) [19]
Vascular	**12.8% (11) [13]**	**15.7% (14) [14]**
Deep Vein Thrombosis (DVT)	11.6% (10) [12]	14.6% (13) [13]
Constitutional	**15.1% (13) [15]**	**16.9% (15) [18]**
Fever	4.7% (4) [4]	6.7% (6) [6]
Positive Cultures	4.7% (4) [4]	7.9% (7) [7]
Urogenital	**27.9% (24) [30]**	**29.2% (26) [32]**
Urinary Tract Infection	16.3% (14) [15]	21.3% (19) [20]
Hematuria	7.0% (6) [6]	1.1% (1) [2]
Urinary Retention	3.5% (3) [3]	5.6% (5) [5]

Conclusion

The data collected on both the primary efficacy endpoint and the primary safety in the TREVO 2 clinical trial demonstrate that the Trevo Retriever is substantially equivalent to the predicate Merci Retriever.

Summary of Substantial Equivalence

The Trevo Retriever is comparable to the predicate device with regard to device design, materials, intended use, and patient population. The conclusions drawn from the verification and validation testing, animal studies and clinical trial conducted using the Trevo Retriever demonstrate that it performs as designed, is suitable for its intended use and is substantially equivalent to the legally marketed predicate device.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Document Control Room –WO66-G609
Silver Spring, MD 20993-0002

Concentric Medical, Inc.
c/o Ms. Kirsten Valley
Vice President, Technology & Regulatory Affairs
301 East Evelyn Avenue
Mountain View, CA 94041

AUG 3 2012

Re: K120961
Trade/Device Name: Trevo Retriever
Regulation Number: 21 CFR 870.1250
Regulation Name: Percutaneous Catheter
Regulatory Class: Class II
Product Code: NRY
Dated: July 30, 2012
Received: July 31, 2012

Dear Ms. Valley:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please go to http://www.fda.gov/AboutFDA/CentersOffices/CDRH/CDRHOffices/ucm115809.htm for the Center for Devices and Radiological Health's (CDRH's) Office of Compliance. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Small Manufacturers, International and Consumer Assistance at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm.

Sincerely yours,

for Malvina B. Eydelman, M.D.
Director
Division of Ophthalmic, Neurological,
and Ear, Nose and Throat Devices
Office of Device Evaluation
Center for Devices and
Radiological Health

Enclosure

Indications for Use

510(k) Number (if known): K120961

Device Name: Trevo Retriever

Indications for Use:

The Trevo Retriever is intended to restore blood flow in the neurovasculature by removing thrombus in patients experiencing ischemic stroke within 8 hours of symptom onset. Patients who are ineligible for intravenous tissue plasminogen activator (IV-tPA) or who fail IV-tPA therapy are candidates for treatment.

Prescription Use __X_____ AND/OR Over-The-Counter Use _____
(Part 21 CFR 801 Subpart D) (21 CFR 807 Subpart C)

(PLEASE DO NOT WRITE BELOW LINE-CONTINUE ON ANOTHER PAGE IF NEEDED)

Concurrence of CDRH, Office of Device Evaluation (ODE)

JOE HUTTER

(Division Sign-Off)
Division of Ophthalmic, Neurological and Ear,
Nose and Throat Devices

510(k) Number K120961